INSTRUCTION MANUAL

MODEL 206B

AC AMPLIFIER

For Serial No._____

INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

INSTRUCTION MANUAL

MODEL 206B

AC AMPLIFIER

For Serial No._____

The Model 206B is the same as the Model 206 with the following exceptions:

1. Page 1-1, "Frequency Response 10 cycles to 100 KC", should read "1 cycle to 100 KC"

2. Schematic C-3981:

   C4 should be 2MFD, 100V

   C5 should be 1000MFD, 6V

   C7, C10 should be 25MFD, 50V

   C8, C11, C14 should be 500MFD, 15V

QUAN-TECH LABORATORIES, INC.

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

INSTRUCTION MANUAL

MODEL 206

AC AMPLIFIER

for Serial No.

Quan-Tech LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

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PRINTED IN U.S.A.

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CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY

Quan-Tech Laboratories, Inc. warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electronic tubes and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misadjustments, misuse, or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

Calibration checks of this instrument can easily be made in accordance with the instruction manual. Routine readjustments should never be attempted. If, however, the instrument has been damaged and requires recalibration or alignment, explicit calibration procedures as defined in the instruction manual must be followed.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid, to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

The instruments should be packed in their original containers, or in a strong exterior container and surrounded by two inches of shock absorbing material.

Quan-Tech LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

A. DESCRIPTION

The Model 206 is a versatile low noise, wide range, general purpose amplifier having selective gains of 10:1, 100:1 and 1000:1. The amplifier has a high input impedance and low output impedance. The frequency response is flat and transient response good, lending its use for the amplification and measurement of complex waveforms including random noise signals.

The instrument is designed with mounting clips and circuitry to provide operation from two Nickel Cadmium Burgess Type CD 24 batteries if operation on both line power or battery power is desired. The batteries are automatically recharged when the line cord is connected to a 117V AC power source.

B. SPECIFICATIONS

Voltage Gain:	10:1, 100:1 and 1000:1, ± 0.5 DB
Frequency Response:	Flat within 0.5 DB, 10 cycles to 100 KC, -3 DB at approximately 1 MC, 650 KC and 500 KC, for gains of 10, 100 and 1000 respectively.
Input Impedance:	Approximately 1 megohm shunted by 30 uuf.
Output Impedance:	Less than 10 ohms in series with 100 uf.
Output Voltage:	3 volts RMS at 6 ma.
Distortion:	Less than 1% at rated output.
Noise:	Equivalent input noise for full bandwidth with input shorted less than 10, 7 and 6 uv for gains of 10, 100 and 1000 respectively. Typical narrow band noise voltage 5×10^{-9} V /√~ Typical narrow band noise current 3×10^{-12} amp. /√~ above 1 KC.
Power Source:	105 - 125 VAC, 50/60 cycles, approx. 2 Watts.
Optional Feature:	Self-contained rechargeable nickel cadmium battery in automatic recharging circuit.
Dimensions:	4"h x 7"w x 6"d including all controls.
Weight:	Approximately 3 lbs.

SECTION 2

OPERATING INSTRUCTIONS

A. OPERATION

1. Connect the line plug to a 105 - 125V 50/60 cycle power source.

2. Throw the BAT.CHG./AMP.ON. switch to AMP.ON.

3. Set the amplifier gain switch to the desired gain (10, 100 or 1000).

4. The amplifier should now be operating and the input and output connectors may be attached.

5. This amplifier is a non-inverting amplifier and the input and output are of the same phase with some phase shift noticeable near the upper and lower frequency extremes.

6. If the amplifier is also equipped with rechargeable batteries the unit will operate for approximately 10 hours without being connected to a line power source. The batteries will recharge in approximately 12 hours in the BAT.CHG. position and will remain in a trickle charge condition as long as the unit is connected to a power source.

7. The following precautions should be observed:

    a. DO NOT apply more than 200 volts DC or 5 volts AC to the input connector.

    b. AVOID applying high voltage transients to the input, as the heavy peak currents may damage the input transistor.

    c. Since the output blocking capacitor is of the low voltage electrolytic type, it should not be connected to a load having a DC voltage component of more than 5 volts.

    d. Input noise and bandwidth are a function of the input signal impedance which should be as low as practicable.

SECTION 3

CIRCUIT DESCRIPTION AND THEORY OF OPERATION

A. GENERAL

1. The design of the Model 206 Amplifier is straightforward and employs only transistors and solid state devices. Reference to the schematic diagram will enable the user to understand the following description.

B. POWER SUPPLY

1. Power is obtained from the secondary winding of T_1. This is rectified by the full wave bridge CR_1, CR_2, CR_3, CR_4, and filtered by capacitor C_1. The DC voltage obtained is used both to recharge the battery or supply power to the amplifier regulated power supply.

2. In the AMP.ON. position of S_1, voltage from either the bridge rectifier or the battery is applied to the collector of pass transistor Q5. C_2 gives additional filtering to this voltage. Control of the pass transistor Q5 is obtained from the collector of Q4 which in conjunction with Q_3 form a differential transistor pair. Q_1 and Q_2, a second differential pair, drive the bases of Q_3 and Q_4 respectively, the base of Q2 being referenced to the zener reference diode CR_5 and the base of Q_1 sensing the error voltage across the divider network consisting of R_2, R_3 and R_4, the whole resulting in an extremely stable, low noise power supply of 15 volts independent of line or battery voltage variations.

C. AMPLIFIER

1. Input to the amplifier from the BNC type UG-290/u input connector is through R_{11} and C_4 to the base of Q_6. CR_6 and CR_7 in conjunction with R_{11} serve as a protective clamp for large input overload signals.

2. The first amplifier section consists of transistors Q_6 and Q_7. A stabilized gain of 10 is obtained by the negative feedback network consisting of R_{16}, R_{17}, R_{18} and R_{19}. A gain of 1 or 10 is obtained by connecting the input of the second amplifier section to either the collector of Q_7 or the emitter of Q_6 through switch S2.

3. The second amplifier section is identical to the first amplifier section.

C. AMPLIFIER (Cont'd)

4. The third amplifier section is similar to the two preceding amplifiers with the exception that the output is obtained from a complementary symmetry push-pull pair Q12 and Q13 providing a low output impedance and wide dynamic range. A 100 uf capacitor isolates the quiescent amplifier DC voltage from the BNC type UG-290/u output connector. The fixed gain of 10 in this stage and the interconnection combination of S_2 permit selective amplifier gains of 10, 100 or 1000.

A. GENERAL

1. The design of the Model 206 is straightforward, employing long life semiconductors, and preventive maintenance is therefore not required. Trouble shooting, if required, may readily be done in sections by referring to the schematic diagram. Standard transistor servicing care should be used throughout. Transistors can be easily damaged with large transient voltages, therefore, take great care not to short any terminals when making measurements on the printed circuit boards. In soldering to the boards, have the iron only hot enough to make a rapid clean solder joint. DO NOT apply any force which would tend to push the copper away from the board.

B. REMOVAL OF INSTRUMENT FROM CASE

1. Remove the line plug from the power source. This MUST be done as power is applied to the power transformer regardless of the switch positions.

2. Remove the four binder head screws located on the top and bottom edges of the front panel. Gently work the panel and attached instrument from the case.

C. BATTERY REMOVAL OR INSERTION (Optional feature)

1. Nickel Cadmium rechargeable batteries have an extremely long life and require no maintenance. They may be left stored in either a charged or discharged condition. If the instrument is used occasionally from an AC power source the batteries will normally be in a fully charged state.

2. Batteries are held in place on the rear printed circuit board by spring clips and may be easily removed or inserted by removing the four binder head screws holding the rear plate which mounts the line fuses and power cord. When inserting these batteries NOTE CAREFULLY the battery polarity and maintain the polarity indicated or damage to the instrument circuitry may result. It is also advisable to wrap a layer of scotch tape around the ends of each battery to prevent the possibility of the spring clips cutting the battery insulating sleeve and possibly short circuiting the battery.

D. CALIBRATION

1. Calibration of the instrument is not required unless the zener diode, CR_5 is replaced. The minus 15 volt supply is adjusted at the factory by selection of resistor R_4 to obtain 15 volts on the main negative regulated buss (Purple wire).

2. Gain calibration is made at the factory by selection of the gain padding resistors R_{18}, R_{27} and R_{36}. These resistors are selected for amplifier gains at 1000 cycles in the following sequence. X10 gain select value of R_{36}, X100 gain select value of R_{18}, X1000 gain select value of R_{27}. All gain positions are adjusted for an accuracy of better than 2%.

SEMICONDUCTOR LEGEND

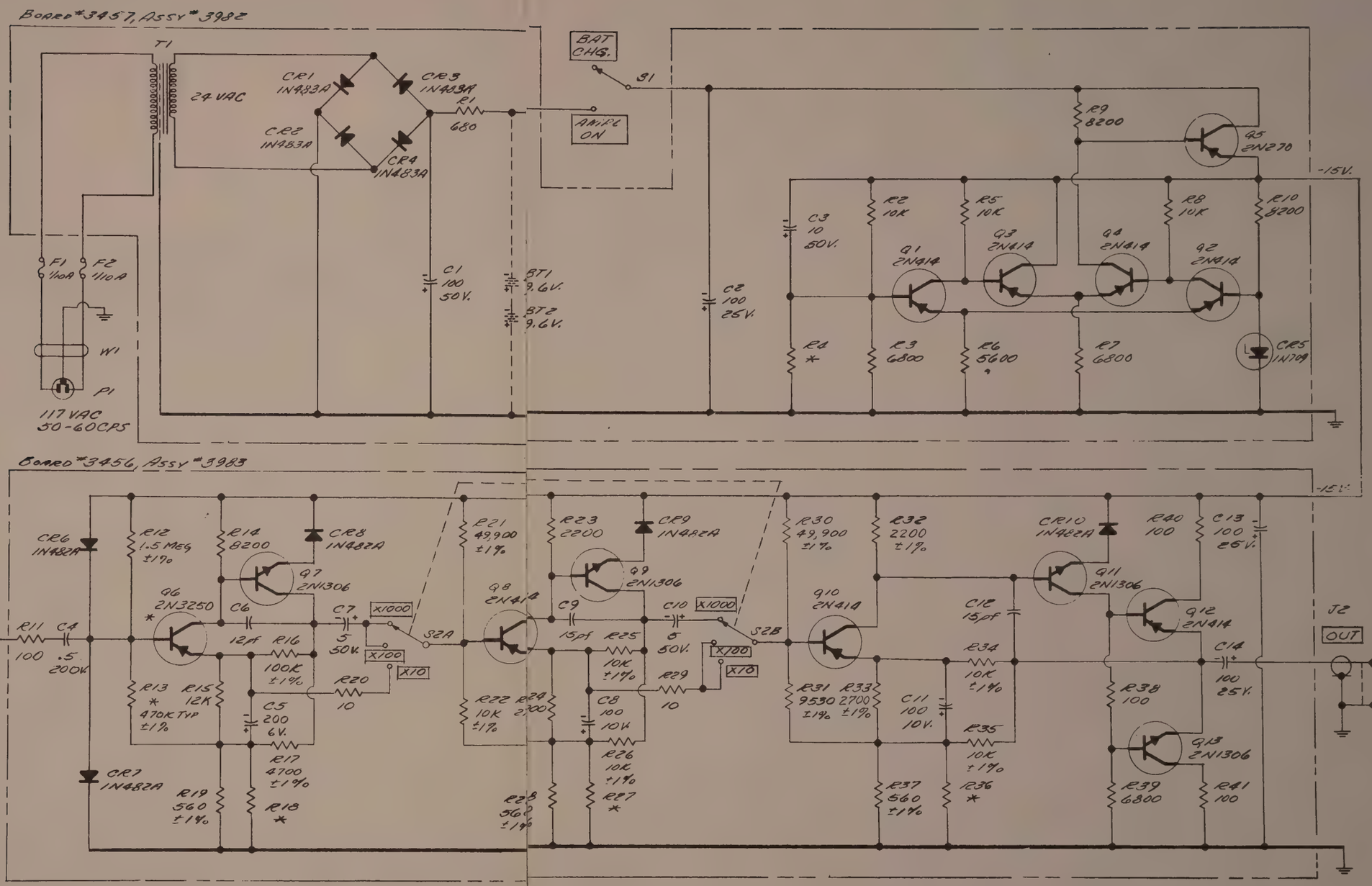
Changes and improvements in the semiconductor products available for commercial use necessitate type changes from time to time. To eliminate confusion and costly paperwork, many of these changes will be covered in the following legend. The purpose of this legend is to acknowledge the fact that the type number on a semiconductor found in a piece of equipment will not necessarily correspond with the type number given on the schematic diagram.

The legend is not intended to be an interchangeability list although in many cases good quality components* within a given category may be substituted with acceptable results. Normally, replacements should be made using components having the same type number as the component being replaced.

Those components bearing an asterisk on the schematic diagram are factory selected components and should be obtained from Quan-Tech Laboratories.

*It should be noted that the incoming inspection procedure followed at Quan-Tech Laboratories includes noise screening on most semiconductors.

TYPE # ON SCHEMATIC	TYPE # IN EQUIPMENT
TI480	2N1613
TI494	2N1613
1N703	1N748
1N709	1N753
1N2859	1N3253, 1N3254
1N2862	1N3254
2N396A	4JX1G759, 4JX1D653
2N414	2N396A, 4JX1G759, 4JX1D653
2N929	220N2, A642, 2N3566
2N1515	2N3644
2N1613	2N3566
2N2219	220N2, A642, 2N3566
2N2603	2N3250
2N3250	2N3644



LEGEND

K = 1000

* = FACTORY SELECT

▭ = FRONT PANEL CONTROL

UNLESS OTHERWISE SPECIFIED:
ALL RESISTANCES IN OHMS.
ALL RESISTORS 1/2 W.
ALL CAPACITANCES IN MICROFARADS.

SCHEMATIC
AC AMPLIFIER
MODEL 206

C-3981-F

Short Form Catalog

INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

Quan-Tech®

GENERAL INSTRUMENTS

• ELECTRONIC INSTRUMENTS • ANALYZERS • AMPLIFIERS • SPECIAL INSTRUMENTS •

WAVE ANALYZERS

MODEL 303
WAVE AND NOISE SPECTRUM ANALYZER

Frequency range: 30 cps to 100 Kc. **Bandpasses:** 10, 30, 100, 1000 cps, selectable at front panel. (100 and 1000 cps bandwidths flat-topped for simplified noise computation, greater accuracy and convenient tuning. **Sensitivity:** 100 μV to 300 v, FS. Down to 1 μV FS with accessory Model 203 preamplifier (see below). ±300 cps vernier; selection of long or short meter time constants; metering circuits compensated to minimize error from instantaneous noise pulses; overload-protected meter; analog output for external monitoring. **Price:** $1475

MODEL 2156 WAVE AND SPECTRUM ANALYZER

Similar to above except: **Frequency range:** 10 cps to 30 Kc. **Bandpasses:** 3, 10, 30, 300 cps. **Price** $1950

MODEL 304
LOW FREQUENCY WAVE & SPECTRUM ANALYZER

Frequency range: 1 cps to 5 Kc; **Bandpasses:** 1, 10 & 100 cps, selectable at front panel; **Skirt Selectivity:** 24 DB per 1/2 bandwidth; **Voltage range:** 30 μV to 100 v, FS; down to 3 μV FS with accessory Model 201B preamplifier (see below); **Tuning:** Manual or automatic; Internally supplied electronic sweep of total frequency range or of any portion; provision for external sweep; **Frequency Calibration:** Linear; **Outputs:** BFO, sample of automatic sweep, analogs of meter readings and frequency setting, phase output for phase plot on X-Y recorder. **Price:** $2350

OPTIONAL FEATURES

Pen lift; AFC; Log, squared, or RMS meter reading; slave operation for multi-channel analyzer system. Prices: Upon request.

SOLID STATE AMPLIFIERS

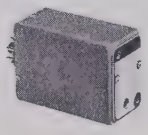
MODEL 201B
DC DECADE AMPLIFIER
AC OR DC COUPLED

Bandwidth: DC or 10 cps to 3Mc (3db); **Gain:** 10 (fixed); Power: Self-contained batteries; 600 hour life. **Price:** $110

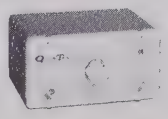
MODEL 203
LOW NOISE AC AMPLIFIER

Bandwidth: 30 cps to 100 Kc (±0.5 db); —3 db at 500 Kc; **Gain:** 100 (fixed); **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. Battery powered; **Price:** $125

MODEL 205
HIGH-STABILITY DC AMPLIFIER



Bandwidth: dc to 100 Kc (0.5 db down); 3 db down at approx. 500 Kc; **Gain:** 10 (fixed); **Typical drift:** less than 250 μv at constant ambient, input shorted. External + & — 12 v required. **Price:** $105



MODEL 206
SELECTABLE GAIN AC AMPLIFIER

Bandwidth: 10 cps to 100 kc (within 0.5db); —3db at 500 Kc. **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. **Gain:** 10, 100 & 1000, selectable at front panel; **Power:** 105-125 v AC or optional self-contained battery pack (automatically recharging). **Price:** $165, Batteries $25.

MODELS 2182 AND 2220
AC INSTRUMENTATION AMPLIFIERS

Modular rack mounted amplifiers having controlled gain vs frequency characteristics. **Max voltage gain:** 10,000. **Attenuation:** 0-75 db in 5 db steps. **Frequency characteristics:** (selected by plug-in cards) voltage gain flat 10 cps to 100 Kc or 10 cps to 20 Kc, rising 3 db/octave 10 cps to 100 Kc or 6 db/octave 10 cps to 20 Kc. **Power:** 105-125 VAC.

MODEL 2182 (shown) mounts four units in a 7" x 19" rack panel. **Price** $455.

MODEL 2220 (not metered) mounts eight units in 7" x 19" rack panel. **Price** $590.

SPECIAL INSTRUMENTS

Quan-Tech manufactures a great many "specials", ranging from one unit only to production quantities on an OEM basis. Our engineering department is extremely flexible and equipped to handle anything from minor modifications of standard instruments to the design and construction of an extremely complicated fully automatic noise measuring system. We are proud of our ability to meet difficult specifications that challenge the state of the art for low noise, stability, and accuracy. Your inquiry will receive a prompt reply.

All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.

Quan-Tech LABORATORIES, INC.

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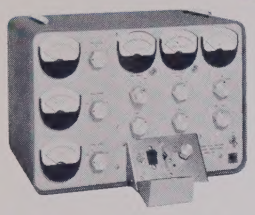
Quan-Tech®

NOISE INSTRUMENTS



MODEL 310 TRANSISTOR NOISE ANALYZER

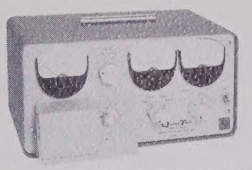
Measures noise current and voltage at 100 cps, 1 Kc and 10 Kc, as well as I_{ebo}, I_{cbo} and beta. **Noise voltage range:** 0.01 to 3 μv/root cycle, FS. **Noise current range:** 1 to 300 pa/root cycle, FS. **Collector current range:** 0.05 to 30 ma. **Collector voltage range:** 0.1 to 30 v. **Base resistance range:** 0, 500, 1K, 10K plus external position. **Price:** $2375

MODEL 311 TRANSISTOR NOISE ANALYZER

Similar to above, except that collector current range is from 5 to 1000 μa for noise measurement in low-collector-current devices. Measures Gm instead of beta. Also measures FET's. **Price:** $2575

MODEL 312 TRANSISTOR NOISE ANALYZER

Similar to Model 310, but designed for measurement of field-effect transistors. **Drain voltage range:** 0.1 to 30 v. **Drain current range:** 0.05 to 30 ma. **Gate Bias range:** 1 v forward to 15 v reverse, continuously adjustable. Also measures transconductance. **Price:** $2575.



MODEL 510 TRANSISTOR NOISE ANALYZER

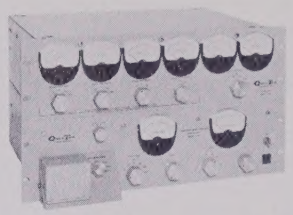
Similar to Model 310 except that it measures noise current and voltage at 1 Kc only. No beta or leakage measurements. **Noise voltage range:** 0.01 to 3 μV/root cycle FS. **Noise current range:** 1 to 300 pa/root cycle FS. **Collector voltage range:** 3 to 30v. **Collector current range:** 0.1 to 10 ma. **Base resistance range:** 0, 500, 1K, 10K ohms plus external position. Also measures FET's. **Price:** $1095.

MODEL 511 TRANSISTOR NOISE ANALYZER

Identical with Model 510 except **Collector current range:** 3 to 300 μa. **Price:** $1145.

MODEL 512 TRANSISTOR NOISE ANALYZER

Similar to Model 510 except that it measures broadband (10 cps to 15.7 Kc) noise figure. **Collector current range:** 10 μa to 1 ma. **Price:** $1145.



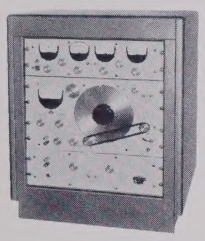
MODEL 2173-2181 TRANSISTOR NOISE ANALYZER

The most versatile unit available. Measures noise current and voltage at 10 and 100 cps, 1, 10, and 100 Kc simultaneously. **Noise voltage range:** 3 to 3000 nanovolts/root cycle FS. **Base resistance range:** 0, 500, 1K, 10K, 100K, and 1M ohms plus external position. **Collector voltage range:** 0.3 to 60 volts. **Collector current range:** 0.3 μa to 30 ma. Also measures FET's. **Price:** $4950.

VERY LOW FREQUENCY NOISE ANALYZER

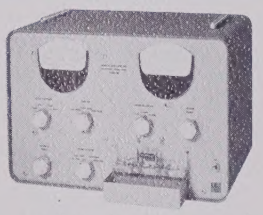
On special order we can supply a test jig and preamplifier for use with the Model 304 Low Frequency Wave and Spectrum Analyzer for making noise measurements at frequencies down to 1 cps. Write us outlining your requirements.

MODEL 2158 NOISE ANALYSIS SYSTEM



Measures noise in any component or system from 30 cps to 100 Kc. Consists of Model 303 Wave Analyzer with motor driven sweep, two preamplifiers, and two metered power supplies. **Preamplifier gain:** 10, 100, 1K, and 10K. **Input impedance:** 100K + 50 pf or 10 meg + 50 pf. **Typical input noise:** 4 x 10^{-9} V and 2 x 10^{-12} A (100K input), 8 x 10^{-9} V and 6 x 10^{-14} A (10 meg input), per root cycle at 1 Kc. **Power Supplies:** 0.1 to 30 volts and 1 to 450 volts at 100 ma. each. Overload protected. **Ripple:** 1 microvolt max. **Price:** $5200.

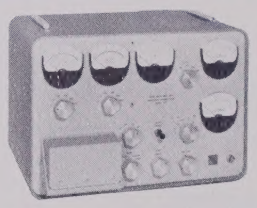
MODEL 315 RESISTOR NOISE TEST SET



Measures noise in resistors in conformance with specifications recommended by NBS and Method 308 of MIL STD 202B. **Test-resistor range:** 100Ω to 22 meg Ω. **Measurement range:** 0.5 μV in a decade to 1000 μV in a decade. **Outputs:** Sample of noise voltage; analogs of meter readings. External cable supplied for remote location of test jig. **Price:** $1950

MODEL 2136

Similar to above, but measures resistors down to 10 Ω. **Price:** $2300



MODEL 327 DIODE NOISE ANALYZER

Measures noise in back-biased semi-conductor diodes at 10 cps and 1 Kc simultaneously. **Noise voltage range:** 0.03 μv to 1 mv/cycle of bandwidth. **Test voltage:** 0 to 500v, continuously variable. **Test current:** 0 to 100 ma, continuously variable. Internally supplied ramp automatically sweeps test current and/or voltage within maximum ratings. A wide variety of outputs for data logging, external monitoring, actuating external equipment, etc. **Price:** $2750

TEST JIG AND TRANSFORMER

For measuring noise in forward-biased diodes up to 100 ma. **Price:** $300.

MODEL 317 AMPLITUDE DISTRIBUTION ANALYZER

Determines amplitude - probability distribution of random signals. **Amplifier response:** 3 db down at approx. 12 cps and 1 Mc; **Switching rate:** 5 Mc; **Amplitude ranges:** 100%, 10%, 1% FS; Normal or "inverted" operation; provision for external sweep of level. **Price:** $450

MODEL 420 RANDOM NOISE GENERATOR

Stable "white" noise output having true gaussian amplitude distribution. **Frequency range:** dc to 100 Kc; **Output voltage:** 0.01 to 1000 μv/root cycle, continuously variable, calibrated; **DC offset:** less than 10 mv at max. output. **Price:** $525

MODEL 2184 DIGITAL RESISTOR NOISE TEST SYSTEM

Digitizes, stores, and presents resistor noise data. Consists of Model 2136 Resistor-Noise Test Set plus three digital voltmeters, storage, timing circuits, and optical and punch-card readout. Automatic sequence converts, sums, and stores five total noise readings, five system noise readings, and applied DC voltage. Presents three data channels simultaneously to punch-card system, plus selectable optical readout of any channel. All digital circuitry designed and built by Quan-Tech. **Price:** $9500.

MODEL 2170-71-72 AUTOMATIC RESISTOR NOISE TEST SYSTEM

High-speed automatic sorting of resistors by Noise Index. Sorts 3000/hr. at ± 1 db tolerance, 6000/hr. at ± 3 db tolerance. Higher speeds obtainable by adding additional channels. **Price:** $12,900. (less mechanical handling)

The above systems and modifications of them can be adapted to measuring noise in transistors and diodes. Write us outlining your requirements.

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A Word About Noise Analysis

Since 1957 when it was founded, Quan-Tech Laboratories has specialized in the amplification and measurement of extremely low level signals approaching the theoretical limits of sensitivity. In order to build equipment of this sort it was necessary to select components having the lowest possible electrical noise for use in the most sensitive parts of the circuit. Noisier components were relegated to places where (it was thought) their noise would not interfere with proper operation. These noisy components exhibited a very high rate of failure compared to the quiet ones, so an intensive study of the reasons for these failures was undertaken.

Investigation showed that those components which exhibited excessive amounts of noise (particularly of the "1/f" type) compared to similar units, usually contained some defect or abnormality which could lead to early failure. This was equally true of resistors, transistors, and diodes, even though the failure mechanism might be different for each device.

This discovery led to the development of specific electrical noise measuring instruments for each type of component. Cooperative programs with manufacturers have proved beyond doubt that noise measurements, properly applied, can locate many types of failure-prone components before they are placed in the circuit, with resultant cost saving and increased reliability. Even manufacturers of such fiercely competitive items as automobile radios, electronic organs, and hearing aids have found noise screening cuts costs and improves product quality.

If you haven't already investigated the benefits of noise analysis, both for reliability and for very low noise applications, why not contact us or our local representative and get the full story?

Quan-Tech Sales Representatives

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201-DI3-3070

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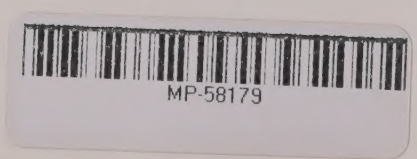
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